Managing Horse Manure for Environmental Benefits

Equine Water Quality Education Series

Horses are important for companionship, sport, work, pleasure, education and therapy. In Louisiana, in addition to playing an important role in the state's economy, horses help maintain open, green spaces that add to our scenic countryside. Horses and the farms on which they live are often quite valuable. To be good stewards of the land, however, horse farmers should manage their farms to minimize negative effects of horse manure on the environment.

This fact sheet gives an overview about the influence of equine physiology on horse manure excretion; horse manure quantity and composition; environmental benefits and detriments of horse manure; nutrient balance of horse farms; horse manure management; and regulatory compliance assistance.

Equine Physiology

Some basic knowledge about horses and how they digest and metabolize food and produce manure (feces and urine) can help to control potential pollution more effectively. Depending on size, age and productive status (work, sport, pleasure, breeding, pregnancy, lactation, retirement), a horse will digest about 60 percent of most feedstuffs.

Feed that is 60 percent digestible indicates that if a horse is fed 25 pounds of dry feed, 15 will be digested and 10 pounds will be excreted as manure (feces). These amounts will vary by feed. Feeds that are higher in fiber such as hays and grasses have a lower digestibility. Conversely, concentrate feeds that contain grains such as corn, oats and/or barley, usually have a higher efficiency of digestion and less fecal excretion.

Nitrogen (N) is a major component of protein. Horses need protein for maintenance, growth, reproduction, lactation and work. Phosphorus (P) is a macromineral needed for maintenance, growth and other physiologic functions. Water is also essential for bodily functions. Water is lost from the body primarily in the excretion of feces and urine, evaporation from the lungs and skin, from sweat and, regarding lactation, from milk.

Water also affects the consistency of manure. All nutrients that are digested (absorbed) are metabolized in the horse's body. Some of these, especially nitrogen in proteins, are excreted in the urine. After being digested and metabolized in the body, waste nitrogen is converted to urea in the liver and excreted in the urine. Additional undigested nitrogen is excreted in the feces.

Overfeeding protein will increase the excretion of nitrogen. Overfeeding phosphorus will increase the excretion of phosphorous, most of which is excreted in the feces. Horses should be fed a diet that is digestible and formulated to meet their nutritional requirements while avoiding excesses.

Specific recommendations for nitrogen (protein) and phosphorus (intakes) are given in the National Resource Council publication, "Nutrient Requirements of Horses."

Manure Quantity and Composition

A 1,000-pound horse will defecate from four to 13 times each day and produce 35 to 50 pounds of wet manure (feces plus urine) daily, or approximately 9.1 tons per year. Typically, a ton of horse manure will contain 11 pounds of N, 2 pounds of P and 8 pounds of potassium (K). To obtain more accurate numbers, manure should be tested for nutrient content.

Manure analysis can be conducted by LSU AgCenter laboratories. To obtain more information, contact your local LSU AgCenter county agent. A horse kept in a stall will require about 10 to 20 pounds of bedding per day. This bedding should be replaced on a regular basis. Because of many types of bedding materials, wood byproducts (shavings, chips, sawdust), straw or paper, the composition of the mix of manure and bedding will vary from farm to farm. In general, manure-plus-bedding will have a volume of between 2 and 3 cubic feet per horse per day.

Environmental Impacts and Benefits

Environmental benefits. When managed properly, manure can be a valuable resource on a farm. Manure can be a source of nutrients for crop production and can improve soil quality. The organic matter present in manure can improve both tilth and water-holding capacity of the soil. Manure also can be used as a fertilizer (N and P) for crops. Most horse owners, however, do not have enough land to use the amount of manure that is produced. Monitoring horse manure so that it does not cause environmental impacts is the goal of manure management.

Nutrients. When not managed properly, horse manure (feces and urine) can pollute the environment, mainly as ground or surface water pollution because of the nutrients nitrogen, phosphorus and carbon (organic matter). These nutrients can reach waterways as surface runoff or leachate from the manure pile.

Nitrogen excreted from horses is usually present either as urea in urine, which is quickly converted to ammonia (NH_3), or it remains in association with organic matter in the feces. Ammonia can be volatilized into the atmosphere.

When excessive nutrients from manure, fertilization, sewage, etc. are deposited in waterways, the waters become rich in mineral and organic nutrients that promote a proliferation of plant life, especially algae, which reduce the dissolved oxygen content and often cause problems like fishkill. This nutrient-enrichment process is referred to as eutrophication.

Regarding nitrogen, the excessive algae and conversion of ammonia to nitrate (NO_3) causes a reduction in dissolved oxygen in the water, which can contribute to fishkills through oxygen depletion.

Nitrogen present in organic matter in the feces is converted in the soil to ammonia and then nitrate, which can be taken up by plants. If plants do not take up nitrate it will easily move through the soil and can eventually leach into the groundwater where it can be a human health concern. Nitrate can also undergo the process of denitrification in the soil and be lost into the atmosphere as gaseous nitrogen (NO, N_2O, or N_2). Phosphorus is also present in manure. When spread on the land it will not leach like nitrogen, unless the soil matrix where phosphorus binds becomes overly saturated with phosphorus.

Phosphorus, however, will run off if applied at the wrong time of the year and/or when soil erosion occurs. This can lead to contamination of surface waters where it may cause eutrophication. When manure is not properly incorporated into the soil, organic matter present in manure, whichcontains carbon, nitrogen and phosphorus, can be a concern when it runs off into surface waters. Eutrophication and additional oxygen depletion may occur because of the decomposition of the organic matter.

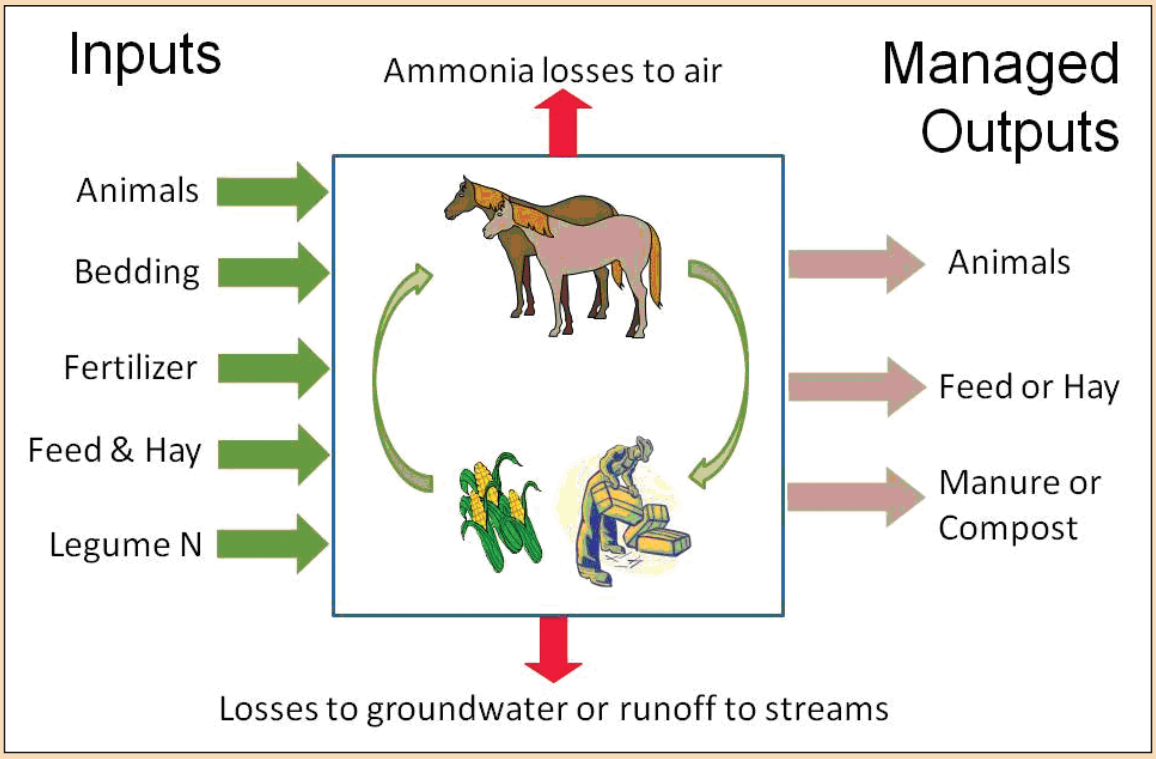
Pathogens and vermin. In addition to the above concerns, pathogens may be present in manure. Some of these are, *E. Coli, Salmonella* and *Cryptosporidium parvum*. The frequency of *Salmonella* and *Cryptosporidium parvum*, however, is low in horse feces, and no known outbreaks of *E. coli* infections in humans have been attributed to horses. Internal parasite infestations in horses also may result from horse manure. Flies, dust, rodents and odors also may be manure-related concerns on horse farms. These problems can be minimized by proper design of housing and manure storage areas and care when turning or moving manure piles.

Nutrient Balance of Horse Farms

When managed properly, nutrients from manure should be viewed as part of an overall cycle occurring on the farm. Nutrients enter the farm as feed or fertilizer and are excreted as manure and subsequently spread on the soil for uptake by plants. The plants are then used as feed or sold from the farm. See diagram below.

Nutrient inputs consist of feed, animals, fertilizer, legumes and bedding. Outputs are animals, milk, meat, manure and crops. Recycling also occurs on the farm, from feed to horse to soil to plant and back to feed again. The optimal goal is for the farm to remain in balance between inputs and outputs without losses either as runoff from manure and soil to surface water or as leachate to groundwater.

Soil can store nutrients assuming that the amount of manure applied to the soil is not excessive. When the land application of manure is not managed properly, heavy rains can cause nutrient runoff to surface water or leachate to groundwater. When land is overmanured and the ability of crops to take up nutrients is exceeded, these nutrients build up in the soil and pose a hazard in ground or surface water. Ideally, farms will be able to maintain a balanced nutrient cycle and prevent



wasteful loss of nutrients as pollution. When managed properly there should be adequate acreage for spreading manure on a farm with this stocking density and maintaining a balance of nutrients. Farms that stable or board horses on smaller acreages may have significantly less available land for spreading. These farms will have to find ways of disposing manure off the farm.

Manure Management

Manure should be removed from stalls or exercise lots on a regular basis. There should be a plan for manure removal. Manure disposal options include removal from the farm by haulers, direct land application or composting with on-farm or off-farm use of compost. Location and size of manure storage sites are important.

Manure storage piles should be kept in a dry area not affected by flooding or storm runoff from other structures or pastures. Do not store manure on a stream bank, near a wetland or in an area that is close to the water table. Store on level ground if possible.

Long-term storage structures, such as composting or stack storage, should have adequate space. The storage structure should have a firm base and be covered to prevent runoff or leaching (tarp or roof). Appropriate conservation practices (buffers, filter strips, etc.) should be implemented to reduce surface loss of manure nutrients if the storage area is not covered.

When spread, manure should be harrowed or otherwise incorporated into the soil. Since nutrient losses from spreading manure should be avoided, manure should be applied based on a soil test and crop or pasture grass nutrient needs. It is important to remember that not all nutrients in manure are immediately available to the present crop. Therefore, previous manure applications must also be considered when applying manure to crops.

Spread only when the crops need nutrients. Avoid spreading on frozen ground or near waterways. Remember that horse manure may contain internal parasites. It is important not to spread horse manure on pastures where horses could become re-exposed to parasites, unless there is a good de-worming program.

Composting of horse manure, when done properly, will result in the destruction of internal parasites. The composted product can then be spread on pastures. Composting is managed, accelerated decomposition of organic materials.

Microorganisms, including bacteria, actinomycetes and fungi, break down the organic materials at elevated

temperatures. Proper decomposition requires the right mix of moisture, air and feedstock. Turning the composting material helps to ensure that all parts of the manure are at elevated temperatures for certain time periods. The final product will be freer of odors than horse manure and may have value as a soil amendment or fertilizer. The composting process also will reduce the total volume of manure for disposal. Siting issues need to be addressed and are similar as discussed under manure storage.

Conclusion

Horse owners need to be aware of how their horses' manure is managed. Nutrient inputs, outputs, cycles and losses all occur on a farm. Recycling of nutrients should be encouraged and losses that contaminate surface or ground water should be eliminated. Horse owners should remember that nutrients have value not only for feeding horses, but also as manure that can have value for the whole farm. It is the horse farmer's responsibility as a land steward to keep that cycle in balance.

References

Rutgers University, *Horses and Manure*. 2004. Fact Sheet 036, by M. Westendorf and U. Krogmann

Agricultural Waste Management Field Handbook. 1992. National Engineering Handbook. USDA Natural Resources Conservation Service.

Livestock Poultry Environmental Stewardship Curriculum. 2001. MidWest Plan Service. Iowa State University. Ames, IA.

New Jersey Department of Agriculture, New Jersey Agricultural Statistics Service and New Jersey Equine Advisory Board. Trenton, NJ.

National Resource Council. 1989. *Nutrient Requirements of Horses* (5th Rev.Ed). National Academy Press, Washington, DC.

Wheeler, E. and J. S. Zajaczkowski. 2002. *Horse Facilities 3: Horse Manure Stable Management*. Pennsylvania State University. State College, PA. www.pubs.cas.psu.edu/freepubs/ubo35.

Authors

Ron E. Sheffield, Ph.D.
Assistant Professor, Department of Biological and Agricultural Engineering, LSU AgCenter

Vinicius R. Moreira, Ph.D.
Assistant Professor, Southeast Research Station, LSU AgCenter

Brian D. LeBlanc, Ph.D.
Associate Professor, W.A. Callegari Environmental Center, LSU AgCenter and Louisiana Sea Grant

Lacey Urick
Assistant Extension Agent, Washington Parish, LSU AgCenter

Carol Franze
Associate Area Agent, Southeast Region, LSU AgCenter and Louisiana Sea Grant

www.lsuagcenter.com

Louisiana State University Agricultural Center
William B. Richardson, Chancellor
Louisiana Agricultural Experiment Station
David Boethel, Vice Chancellor and Director
Louisiana Cooperative Extension Service
Paul D. Coreil, Vice Chancellor and Director

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